

## Claims:

1. A process for the production of particles of a material wherein:

5 a stream of a dispersion of the material in a solvent and a stream of a compressible fluid antisolvent substance are brought into contact with each other so that the streams combine to form a mixture under conditions such that the substance is in compressible fluid antisolvent state,

10 the mixture is then caused to flow along a conduit extending downstream from the region where the streams come into contact, toward an orifice opening from the conduit, the pressure and temperature of the mixture in the conduit being such that the compressible fluid antisolvent substance remains in a compressed state over at least part of the length of the conduit,

15 then the mixture is caused to flow into a downstream region in which the compressible fluid antisolvent substance decompresses into a gaseous state and the material is isolated in a particulate state.

20 2. A process according to claim 1 characterised in that the compressible fluid antisolvent substance is a substance in supercritical fluid state, and when the substance decompresses the substance expands and converts into a gaseous state.

3. A process according to claim 1 or claim 2 characterised in that the compressible fluid antisolvent substance comprises carbon dioxide.

25 4. A process according to claim 3 characterised in that the carbon dioxide is at a pressure above ca. 30 bar.

5. A process according to claim 4 characterised in that the carbon dioxide is in a supercritical fluid state.

30 6. A process according to any preceding claim characterised in that the solvent is an organic solvent selected from  $C_{1-5}$  alkyl  $C_{1-5}$  alkanolate esters,  $C_{1-5}$  alcohols, and di-  $C_{1-5}$  alkyl ketones, halogenated organic solvents, water, and mixtures thereof.

7. A process according to any preceding claim characterised in that the solvent is saturated or near saturated with the material.

5 8. A process according to any one of claims 2 to 7 characterised in that a supercritical fluid substance : dispersion ratio of 50 or less : 1 is used.

9. A process according to any one of the preceding claims characterised in that one or more additives and/or modifiers are introduced into the mixture of the material, the solvent  
10 and the compressible fluid antisolvent substance.

10. A process according to claim 9 characterised in that one or more of the additives is a solid, and is introduced as a dispersion in a carrier vehicle.

15 11. A process according to claim 9 or 10 characterised in that the additive and/or modifier is introduced into the input stream of dispersion of the material and/or the compressible fluid antisolvent substance.

12. A process according to claim 9 or 10 characterised in that the additive and/or  
20 modifier is mixed with one or both of the input streams before this is inputted.

13. A process according to claim 9 or 10 characterised in that the one or more additives and/or modifier is separately introduced into the region where the streams mix

25 14. A process according to claim 9 or 10 characterised in that the one or more additives and/or modifier is introduced into the mixture of the dispersion and the compressible fluid antisolvent substance at the region where the streams of dispersion and compressible fluid antisolvent substance contact each other.

30 15. A process according to claim 9 or 10 characterised in that the one or more additives and/or modifier is introduced into the mixture of the dispersion and the compressible fluid

antisolvent substance in the conduit between the region where the solution and the compressible fluid antisolvent substance meet and the orifice.

16. A process according to claim 9 or 10 characterised in that the one or more additive is introduced into the mixture at a point downstream of the part of the process where the compressible fluid antisolvent substance decompresses.

17. A process according to any one of claims 9 to 16 characterised in that the one or more additive is an excipient material.

18. A process for forming a co-formulation of a material and an additive in which a mixture of a material and an additive is produced by introducing the additive, in a fluid carrier vehicle, into a stream comprising the material and a compressible fluid antisolvent substance, and then causing the mixed stream to flow into a downstream region where the compressible fluid antisolvent substance decompresses.

19. A process according to any preceding claim characterised in that the pressure and temperature of the mixture in the conduit are maintained by means of the dimensions of the conduit being such as to generate a back pressure in part or all of the conduit between the region where the streams meet and the orifice.

20. A process according to any preceding claim characterised in that a pressurised gas is introduced into the flow of mixture between the region where the streams meet and the orifice.

21. A process according to any preceding claim characterised in that the flow of the mixture is restricted in the conduit, between an upstream high pressure zone and a downstream lower pressure zone, and a flow control fluid is introduced into the conduit upstream of the restriction, the pressure of the flow control fluid being equal to or greater than the pressure of the flowing fluid upstream of the restriction.

22. A process according to any preceding claim characterised in that a heat carrier fluid may be introduced into the mixture flowing along the conduit.

23. A process according to any preceding claim characterised in that in the downstream region the pressure is around atmospheric, and the temperature is 0-50° C.

24. A process according to any one of the preceding claims, characterised by drying means in the downstream region.

25. A process according to claim 24, characterised in that materials carried in an aqueous vehicle are dried by the drying means.

26. A process according to claim 24 or 25 characterised in that the drying means entrains the particles in the downstream region in a stream of gas.

27. A process according to any preceding claim characterised in that particles which are formed in the process are collected.

28. A particulate product material made using a process as claimed in any preceding claim.

29. An apparatus suitable for performing a process as claimed in claim 1 comprising:  
means (11, 13, 21, 23, 31, 33) for bringing a stream of a dispersion of the material in a solvent and a stream of a compressible fluid antisolvent substance into contact with each other such that the streams combine to form a mixture under conditions such that the substance is in a compressible fluid antisolvent state,

a conduit (17, 27, 37) extending downstream from the region where the streams come into contact toward an orifice (18, 28, 38), along which the mixture can flow,

means to cause the pressure and temperature of the mixture in the conduit (17, 27, 37) to be such that the substance remains in a compressible fluid antisolvent state along at least part of the conduit (17, 27, 37),

a region (19, 29, 39) in downstream communication with the orifice in which region the pressure and temperature conditions are such that the compressible fluid antisolvent substance decompresses and the material is recovered as a solid.

5 30. An apparatus according to claim 29, characterised by:

means (11, 13, 21, 23, 31, 33) for bringing a stream of a dispersion of the material in a solvent and a stream of a supercritical fluid substance into contact with each other such that the streams combine to form a mixture under conditions such that the substance is in a supercritical fluid state,

10 a conduit (17, 27, 37) extending downstream from the region where the streams come into contact toward an orifice (18, 28, 38), along which the mixture can flow,

means to cause the pressure and temperature of the mixture in the conduit (17, 27, 37) to be such that the substance remains in a supercritical fluid state along at least part of the conduit (17, 27, 37),

15 a region (19, 29, 39) in downstream communication with the orifice (18, 28, 38) in which region the pressure and temperature conditions are such that the substance converts into a gaseous state and the material is recovered as a solid.

20 31. An apparatus according to claim 29 or 30 characterised by a "T" or "Y" tube system (15, 25) to bring the dispersion of the material and the compressible fluid antisolvent substance into contact with each other and to provide the conduit (17, 27).

25 32. An apparatus according to claim 31 characterised in that the material may be metered to one limb (11, 21) of the "T" or "Y" tube, and to another limb (13, 23) of the temperature controlled T or Y tube may be metered the compressible fluid antisolvent substance, and the third limb of the T or Y comprises the conduit (17, 27).

30 33. An apparatus according to claim 32 characterised in that the orifice (18, 28, 38) is provided at the end of the limb remote from the junction (15, 25) of the limbs.

34. An apparatus according to any one of claims 29 to 33 characterised by introduction (319, 325) means for the introduction of one or more additive and/or modifier.

35. An apparatus according to claim 34 characterised in that the introduction means comprises an "X" tube arrangement (31, 33, 325, 37), the respective streams of dispersion of material and compressible fluid antisolvent substance being introduced via two  
5 respective limbs (31, 33) of the "X" tube arrangement, the additive being introduced into the flow via a third limb (325) of the "X" tube, and the fourth limb (37) of the "X" comprising the conduit.

36. An apparatus according to claim 35 characterised in that the introduction means  
10 comprises a further "T" or "Y" tube arrangement (37, 319), located downstream of the point where the dispersion and compressible fluid antisolvent substance meet.

37. An apparatus according to any one of claims 29 to 36 characterised by a conduit  
15 (17, 27, 37) having dimensions such as to generate a back pressure in part or all of the conduit between the region where the streams meet and the orifice (18, 28, 38).

38. An apparatus according to any one of claims 29 to 37 characterised by pressurised  
gas introduction means (214) to introduce a pressurised gas directly into the conduit (27).

20 39. An apparatus according to any one of claims 29 to 38 characterised by a drying means to dry particles which are formed.

40. An apparatus according to claim 39 characterised in that the drying means  
25 introduces a stream of heated air around the orifice.

41. An apparatus according to any one of claims 29 to 40 provided with a downstream  
region for collection of the particles.